

-1-

TRAVELING DEVICE OF TRANSFER CRANE



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BACKGROUND OF THE INVENTION

5 Field of the Invention

The present invention relates to a transfer crane, and more particularly, the present invention relates to a traveling device of a transfer crane, which uses only one tire rotating section and one steering angle fixing section per an underframe constituting the traveling device of a transfer crane, can reliably prevent tires from being deviated inward or outward during forward and backward movement, standing rotation and sideward migration of the transfer crane and can fixedly maintain tires at respective steered angles.

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Description of the Related Art

A transfer crane serves as a kind of portal crane 1 wherein, as shown in FIG. 1, a pair of girders 3 are supported by four leg members 2 and a trolley 4 is mounted on the pair of girders 3 to transfer cargo 5. The transfer crane is widely used to transfer cargo 5 such as a container box, at a container wharf or a container storing place.

A transfer crane 1 is provided with a traveling device 100 which steers and travels the transfer crane 1 to and in a desired direction. Generally, in the traveling device 100,

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-2-

four underframes 110 each having two or four tires support a pair of saddle beams 6 of the transfer crane 1. The transfer crane 1 can be freely capable of forward and backward movement, standing rotation and sideward migration by the aid of the traveling device 100 having the underframes 110 to each of which tires are mounted.

FIG. 2 is a schematic view of an underframe illustrating an example of a conventional traveling device applied to a transfer crane. As shown in FIG. 2, each underframe 110 has front and rear separate bodies 130 rotatably disposed around a pair of supporting shafts 120, respectively, which support the crane 1. In the case that the crane 1 is supported by eight tires, one tire 140 is drivably mounted to each separate body 130. Otherwise, in the case that the crane 1 is supported by sixteen tires, two tires are drivably mounted to each separate body 130. A travel driving section 150 for driving the tires 140 is provided to each underframe 110. Each separate body 130 of the underframe 110 has a rotating hydraulic cylinder 160 for changing a steering angle of the tire 140 and a fixing hydraulic cylinder 170 for fixing the tire 140 at a steered state.

In other words, the conventional traveling device 100 of the transfer crane 1, which employs the construction of the underframe 110 as shown in FIG. 2, includes four travel driving sections 150, eight rotating hydraulic cylinders 160

-3-

and eight fixing hydraulic cylinders 170.

In the conventional traveling device 100 constructed as mentioned above, a problem is caused in that, since the rotating hydraulic cylinder 160 and the fixing hydraulic cylinder 170 are mounted to each separate body 130 of the underframe 110, a structure of the traveling device 100 is complicated, weight is increased and a high manufacturing cost is required.

Also, in the conventional traveling device 100 as shown in FIG. 2, by individually driving two rotating hydraulic cylinders 160 which are provided for two tires 140, respectively, in each underframe 110, a difference is achieved between steering angles of the two tires 140 which run along outer and inner circumferences, respectively, whereby deviation of the tires 140 upon standing rotation of the transfer crane 1 is prevented.

However, a difficulty is induced in that all the rotating hydraulic cylinders 160 must be individually and precisely controlled so as to accurately hold all the tires 140 orthogonal to lines extending through a rotation center of the crane 1.

FIG. 3 is a schematic view of another underframe illustrating another example of another conventional traveling device applied to a transfer crane. As shown in FIG. 3, an underframe 210 for this conventional traveling device is

-4-

constructed in the same manner as the aforementioned underframe 110 of FIG. 2 in that two separate bodies 230 are rotatably disposed around a pair of supporting shafts 220, respectively, which support the crane 1 and at least one tire 240 is mounted to each separate body 230.

The underframe 210 employed in this example is differentiated from the aforementioned underframe 110 of FIG. 2 in that, because only one rotating hydraulic cylinder 260 and one fixing hydraulic cylinder 270 are used in each underframe 210 and two separate bodies 230 constituting the underframe 210 are connected with each other by a connecting rod 280, when a steering angle of one tire 240 of one separate body 230 is changed, a steering angle of the other tire 240 of the other separate body 230 is also changed in an interlocked manner through the connecting rod 280, whereby steering angles of front and rear tires 240 are simultaneously adjusted by the same amount.

The conventional traveling device as shown in FIG. 3 provides advantages in that the numbers of the rotating hydraulic cylinders 260 and the fixing hydraulic cylinders 270 are cut down to halves of those of the rotating hydraulic cylinders 160 and the fixing hydraulic cylinders 270 as shown in FIG. 2, whereby the construction of the entire traveling device is simplified. However, due to a structural limitation that, during standing rotation of the transfer crane 1, the

respective tires 240 cannot be held orthogonal to a rotation center of the crane 1 and instead, a frame center line L1 of the underframe 210 cannot but extend through the rotation center of the crane 1, the conventional traveling device suffers from defects in that all the tires 240 cannot be arranged parallel to tangential lines drawn on a rotational locus of the transfer crane 1 and cannot but run in slightly deviated states, by which it is impossible to originally eliminate a possibility of inward or outward deviation of the tires 240.

This problem of the conventional traveling device of FIG. 3 is more seriously predominated when effecting standing rotation of the transfer crane 1. Concretely speaking with reference to FIG. 4, assuming that a center O1 is the rotation center of the transfer crane 1 and two vertical lines are center lines of left and right underframes 210, respectively, which are spaced apart from each other by the same distance, direction change of the tires 240 of each underframe 210 is conducted in a manner such that two parallel sides of a parallelogram defined by two separate bodies 230 which are connected with each other by the rotating hydraulic cylinder 260 and the connecting rod 280, are rotated. Therefore, the front tire 240' and the rear tire 240'' of each underframe 210 cannot but be steered to the same steering angle.

Consequently, when the tires 240 of four underframes 210

-6-

run along a circumference of a circle C to effect standing rotation of the transfer crane 1, the front tires 240' of the front underframes 210' and the rear tires 240'' of the rear underframes 210'' are caused to run along a circle which is increased in its radius by the distance of)R in comparison with a circle along which the rear tires 240'' of the front underframes 210' and the front tires 240' of the rear underframes 210'' run.

As a result of this, if the front tires 240' of the front underframes 210' and the rear tires 240'' of the rear underframes 210'' which run along the outer circumference and the rear tires 240'' of the front underframes 210' and the front tires 240' of the rear underframes 210'' which run along the inner circumference, are driven at the same speed, the formerly mentioned tires have a reduced angular velocity when compared to the latterly mentioned tires. Hence, as the underframes 210 are biased inward or outward due to a difference in angular velocity between the formerly mentioned tires and the latterly mentioned tires, proper standing rotation of the transfer crane 1 is obstructed and partial wear of the tires occurs.

In this connection, even in the case of relatively increasing a speed of the front tires 240' of the front underframes 210' and the rear tires 240'' of the rear underframes 210'' which run along the outer circumference, the

problem associated with the bias or deviation of them is not solved. That is to say, by the fact that the two separate bodies 230 of each underframe 210 are connected with each other by the rotating hydraulic cylinder 260 and the connecting rod 280 to define substantially a contour of the parallelogram as described above, since the front and rear tires 240' and 240'' of each underframe 210 cannot but be changed in direction only by the same angle, when drawing a line from a center of each of the front and rear tires 240' and 240'' to the rotation center 01 of the transfer crane 1 and a line orthogonal to an axis of each of the front and rear tires 240' and 240'', it is to be readily understood that a great difference exists between steering angles A and A' of the front and rear tires 240' and 240'', respectively, of each underframe 210, each of which is defined by the two lines.

In FIG. 4, due to the fact that the rotational locus of the transfer crane 1 is the circle C which extends through centers of the respective underframes 210, and a running direction of each tire 240 is parallel to a tangential line which is drawn on the circle C, if the standing rotation of the transfer crane 1 is effected along the rotational locus, the left front underframe 210'a and the right rear underframe 210''b are biased inward and the left rear underframe 210''a and the right front underframe 210'b are biased outward. As a consequence, even in the case that running speeds of the front

-8-

tires 240' and rear tires 240" of the respective underframes are differentiated from each other, smooth rotation of the transfer crane is not ensured.

5 This drawback is worsened in the case of a 16-wheeled crane in which each underframe is provided with a pair of front tires and a pair of rear tires. Namely, in the case of the 16-wheeled crane, because four tires which are mounted to each underframe, have different rotation radii, tangential directions and angular velocities upon standing rotation of
10 the transfer crane 1, deviation of the tires is increased and thereby smooth rotation of the transfer crane 1 cannot be guaranteed. Moreover, since a rotation radius of the 16-wheeled transfer crane 1 is remarkably increased in comparison with a width thereof, space efficiency of a container wharf or
15 a container storing place is largely deteriorated.

In this sense, while in the conventional art, an 8-wheeled crane is mainly used rather than a 16-wheeled crane, because the 8-wheeled crane has a ground contact pressure which is two times that of the 16-wheeled crane, it cannot be
20 adequately used on weak foundation. Also, since the container wharf or container storing place must be designed to bear the increased allowable ground contact pressure, additional expenses are required for foundation work or concrete work.

Accordingly, the present invention has been made in an effort to solve the problems occurring in the related art, and a primary object of the present invention is to provide a traveling device of a transfer crane, which uses only one tire rotating section per an underframe and can reliably prevent tires from being deviated inward or outward upon travel including forward and backward movement, standing rotation and sideward migration of the transfer crane.

Another object of the present invention is to provide a traveling device of a transfer crane, which uses only one steering angle fixing section per an underframe and can fixedly maintain tires at steered angles which respectively enable forward and backward movement, standing rotation and sideward migration of the transfer crane.

According to one aspect of the present invention, there is provided a traveling device of a transfer crane including a plurality of underframes each having front and rear separate bodies to each of which at least one tire is mounted, the traveling device comprising: a travel driving section mounted to at least one of the front and rear separate bodies of each underframe, for driving tires; a tire rotating section acting on one of the front and rear separate bodies of each underframe, for providing steering force to at least one tire mounted thereto; a connecting section connected between the

-10-

front and rear separate bodies in a manner such that a difference is induced between steering angles of them, for transmitting the steering force which is provided to the one of them, also to the other of them; and a steering angle
5 fixing section for fixing steering angles of the front and rear separate bodies to desired ones.

According to another aspect of the present invention, the connecting section comprises a long connecting rod connected to one of the front and rear separate bodies, a
10 short connecting rod connected to the other of the front and rear separate bodies, and a joint link having one end which is coupled to the underframe between the front and rear separate bodies and the other end to which the long connecting rod and the short connecting rod are connected.

15 According to still another aspect of the present invention, the steering angle fixing section comprises a rotating yoke which is mounted to one of the front and rear separate bodies to be integrally rotated therewith and is formed with engaging grooves in a manner such that the
20 engaging grooves correspond to steering angles of the tires which enable forward and backward movement, standing rotation and sideward migration of the transfer crane, respectively, and a fixing cylinder having an engaging pin which is selectively engaged into one of the engaging grooves to
25 fixedly maintain a steered state of one of the front and rear

separate bodies.

BRIEF DESCRIPTION OF THE DRAWINGS

5 The above objects, and other features and advantages of the present invention will become more apparent after a reading of the following detailed description when taken in conjunction with the drawings, in which:

10 FIG. 1 is a schematic perspective view illustrating a construction of a conventional transfer crane;

 FIG. 2 is a schematic view of an underframe illustrating an example of a conventional traveling device applied to a transfer crane;

15 FIG. 3 is a schematic view of another underframe illustrating another example of another conventional traveling device applied to a transfer crane;

 FIG. 4 is a view illustrating an arrangement of underframes for explaining a problem caused upon standing rotation of the traveling device of FIG. 3;

20 FIGS. 5 through 7 are schematic plan views of an underframe illustrating a construction of a traveling device of a transfer crane in accordance with an embodiment of the present invention, wherein FIG. 5 shows tires steered to enable the transfer crane to be capable of forward and
25 backward movement, FIG. 6 shows the tires steered to enable

-12-

the transfer crane to be capable of standing rotation and FIG. 7 shows the tires steered to enable the transfer crane to be capable of sideward migration;

FIGs. 8 through 10 are schematic views illustrating operations of limit switches installed on a steering angle fixing section of the traveling device, wherein FIG. 8 shows a state in which steering angles of the tires are fixed for the forward and backward movement of the transfer crane, FIG. 9 shows another state in which steering angles of the tires are fixed for the standing rotation of the transfer crane and FIG. 10 shows still another state in which steering angles of the tires are fixed for the sideward migration of the transfer crane; and

FIG. 11 is a view illustrating operations of limit switches installed on a rear separate body.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Reference will now be made in greater detail to a preferred embodiment of the invention, an example of which is illustrated in the accompanying drawings. Wherever possible, the same reference numerals will be used throughout the drawings and the description to refer to the same or like parts.

FIGs. 5 through 7 are schematic plan views of an

underframe illustrating a construction of a traveling device of a transfer crane in accordance with an embodiment of the present invention, wherein FIG. 5 shows tires steered to enable the transfer crane to be capable of forward and backward movement, FIG. 6 shows the tires steered to enable the transfer crane to be capable of standing rotation and FIG. 7 shows the tires steered to enable the transfer crane to be capable of sideward migration; FIGs. 8 through 10 are schematic views illustrating operations of limit switches installed on a steering angle fixing section of the traveling device, wherein FIG. 8 shows a state in which steering angles of the tires are fixed for the forward and backward movement of the transfer crane, FIG. 9 shows another state in which steering angles of the tires are fixed for the standing rotation of the transfer crane and FIG. 10 shows still another state in which steering angles of the tires are fixed for the sideward migration of the transfer crane; and FIG. 11 is a view illustrating operations of limit switches installed on a rear separate body.

First, a construction of a traveling device of a transfer crane in accordance with an embodiment of the present invention will be described hereinafter with reference to, as an example, a 16-wheeled transfer crane shown in FIG. 5. The traveling device 10 of a transfer crane according to the present invention can be applied to the aforementioned

-14-

transfer crane 1 having four underframes 20 each of which includes front and rear rotatable separate bodies 30 to each of which two tires 40 are mounted. Each of the four underframes 20 is structured in a manner such that it
5 basically includes one travel driving section 50, one tire rotating section 60, one connecting section 70 and one steering angle fixing section 80.

The travel driving section 50 functions to supply driving force to the tires 40 thereby to enable the transfer
10 crane 1 to be traveled. The conventional driving apparatuses which can be commonly applied to the transfer crane 1, may be used as the travel driving section 50. Since a concrete construction and a power transmission scheme of the travel driving section 50 are not directly related with
15 characterizing features of the present invention, detailed descriptions thereof will be omitted herein.

In the present invention, while two travel driving sections may be mounted to both of the front and rear separate bodies 30' and 30'', respectively, for directly driving all
20 tires 40 of each underframe 20, it is preferred in view of a constructional simplification of the entire traveling device that power be directly transmitted only to the rear tires 40'' and the front tires 40' be idly rotated, as shown in FIG. 5. In this case, as can be readily seen from FIGs. 5 through
25 7, the travel driving section 50 is mounted to the rear

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-15-

separate body 30" to be integrally rotated therewith upon implementing steering operation.

In order to change a traveling direction of the transfer crane 1, the tires 40 must be rotated by predetermined angles around a pair of supporting shafts 11 which support the transfer crane 1. To this end, in the traveling device 10 according to the present invention, a tire rotating section 60 is provided for each underframe 20.

The tire rotating section 60 is not specifically limited to a specific structure so long as it can rotate the tires 40 into desired steering directions. In this regard, it is preferred that a hydraulic cylinder 61 be used to constitute the tire rotating section 60 in a manner such that one end of the hydraulic cylinder 61 is rotatably fastened to a support 21 of the underframe 20 and the other end of the hydraulic cylinder 61 is rotatably connected to any one of the separate bodies 30' and 30" of the underframe 20 in a state wherein the other end of the hydraulic cylinder 61 is spaced apart from the supporting shaft 11' or 11", as shown in FIGs. 5 through 7.

In this preferred embodiment of the present invention, it is illustrated that a first crank plate 62' is securely mounted to the front separate body 30' to be integrally rotated therewith and the hydraulic cylinder 61 is connected between the first crank plate 62' and the support 21 of the

- 2 APR 2004

-16-

underframe 20. By the construction of the tire rotating section 60 as described above, if the hydraulic cylinder 61 is actuated, as the first crank plate 62' is rotated around the supporting shaft 11', the front separate body 30' is also
5 rotated around the supporting shaft 11', whereby a steering angle of the tires 40' mounted to the front separate body 30' is changed.

In the traveling device 10 of a transfer crane according to the present invention, because only one tire rotating
10 section 60 is mounted to each underframe 20 to supply steering force directly to the tires 40' of one separate body (for example, the front separate body 30') thereby to steer the tires 40, it is necessary that the steering force of the tire rotating section 60 be also applied to the tires 40" of the
15 other separate body (for example, the rear separate body 30") to which the steering force of the tire rotating section 60 is not directly supplied. In other words, a provision for transmitting the steering force of the tire rotating section 60 from the front separate body 30' to the rear separate body
20 30" is required.

To this end, in the present invention, the connecting section 70 is arranged between the front separate body 30' and the rear separate body 30" to transmit the steering force of the tire rotating section 60 therebetween. According to the
25 present invention, the connecting section 70 is constructed in

a manner such that, when a steering angle of the tires 40 must be maintained at 0° or 90° for forward and backward movement or sideward migration of the transfer crane 1, all the tires 40 are accurately held at the steering angle of 0° or 90° as shown in FIGs. 5 or 7, and, when the tires 40 must be steered to their predetermined steering angles suitable for the standing rotation of the transfer crane 1, steering angles of the front tires 40' of the front separate body 30' and the rear tires 40'' of the rear separate body 30'' are differentiated from each other. Consequently, as described above with reference to FIG. 4, the connecting section 70 of the present invention constitutes one of characterizing features of the traveling device 10 according to the present invention, in that all the tires 40 of the underframe 20 are held orthogonal to lines extending through a center of a standing rotation locus of the transfer crane 1, whereby inward or outward deviation of the tires is prevented.

That is to say, the connecting section 70 which constitutes one of characterizing features of the traveling device 10 according to the present invention, connects the front separate body 30' and the rear separate body 30'' with each other, in a manner such that, when the standing rotation of the crane 1 is effected, depending upon a position (a front position and a rear position) of each underframe 20 with respect to the crane 1 and a position (a front position and a

-18-

rear position) of the tires 40 in each underframe 20, the tires 40 running along an inner circumference and the tires 40 running along an outer circumference are held orthogonal to the lines extending through the center of the standing rotation locus of the transfer crane 1. When the crane 1 is standingly rotated in a counterclockwise direction as in FIG. 6, a steering angle 21 of the front tires 40' is determined to be larger than a steering angle 22 of the rear tires 40'', whereby the front tires 40' running along the outer circumference and the rear tires 40'' running along the inner circumference are held orthogonal to the lines extending through the center of the standing rotation locus of the transfer crane 1, as described above.

It is preferred that the connecting section 70 for differentiating the steering angle of the front separate body 30' and the steering angle of the rear separate body 30'' from each other, comprises, as shown in FIGs. 5 through 7, a long connecting rod 71 connected to the front separate body 30', a short connecting rod 72 connected to the rear separate body 30'', and a joint link 73 having one end which is rotatably fastened to the support 21 of the underframe 20 between the front and rear separate bodies 30' and 30'' and the other end which connects the long connecting rod 71 and the short connecting rod 72 with each other.

The long connecting rod 71 is rotatably connected at one

-19-

end thereof to a side of the first crank plate 62' which side is opposite to another side to which the hydraulic cylinder 61 is connected, so that the long connecting rod 71 is spaced apart from the supporting shaft 11' by a predetermined distance. The long connecting rod 71 extends toward the rear separate body 30". Hence, if the tire rotating section 60 is actuated to rotate the front separate body 30' in a counterclockwise direction, for example, from a state shown in FIG. 5 toward a state shown in FIG. 6, the long connecting rod 71 is horizontally pivoted to approach the rear separate body 30".

As the long connecting rod 71 is pivoted rearward, the joint link 73 which is connected to the long connecting rod 71, is rotated in a clockwise direction about one end thereof which is rotatably fastened to the support 21. Moreover, as the joint link 73 is rotated, the short connecting rod 72 which is connected to the joint link 73, is also pivoted rearward.

A second crank plate 62" is mounted to the rear separate body 30" to be integrally rotated therewith. Since the short connecting rod 72 is connected at one end thereof to a side of the second crank plate 62" which side is positioned on the same portion (that is, a left portion of the underframe 20 in FIG. 5) of the underframe 20, along with the side of the first crank plate 62' to which the long connecting rod 71 is

-20-

connected, in a manner such that the short connecting rod 72 is spaced apart from the supporting shaft 11" by a predetermined distance, if the short connecting rod 72 is pivoted rearward, the rear separate body 30" is rotated in the same counterclockwise direction where the front separate body 30' is rotated, in synchronism with the front separate body 30'.

At this time, depending upon dimensions of the crane 1 which are inherently given for each crane, such as a radius of standing rotation and a distance between the front and rear separate bodies 30' and 30", by adequately determining a first point where the hydraulic cylinder 61 of the tire rotating section 60 is connected to the first crank plate 62', a distance from the first point to the supporting shaft 11', a second point where the long connecting rod 71 is connected to the first crank plate 62', a distance from the second point to the supporting shaft 11', a length of the long connecting rod 71, an installation position and a length of the joint link 73, a third point where the short connecting rod 72 is connected to the second crank plate 62", a distance from the third point to the supporting shaft 11", and so forth, it is possible to rotate the front separate body 30' and the rear separate body 30" at different steering angles, respectively, in conformity with the radius of standing rotation which is inherently owned by the transfer crane 1 to which the

traveling device according to the present invention is applied.

FIG. 6 illustrates an example in which lengths and installation positions of the respective constitutive elements are set in a manner such that steering angles of the front and rear separate bodies 30' and 30'' are 21 and 22, respectively, to enable the standing rotation of the transfer crane 1. By this steering angle establishment, all the tires of the crane 1 are positioned orthogonal to the lines, respectively, extending through the center of the standing rotation locus of the transfer crane 1, whereby inward or outward deviation of the tires is originally prevented.

If the tire rotating section 60 is further actuated in the state shown in FIG. 6, the front and rear separate bodies 30' and 30'' are steered to positions where they are rotated by 90° from the forward and backward movement positions shown in FIG. 5. In these 90°-rotated positions, sideward migration of the transfer crane 1 can be executed.

After the front and rear separate bodies 30' and 30'' are set to have predetermined steering angles for effecting the forward and backward movement, standing rotation or sideward migration, it is necessary to fix the steering angles of the tires 40 so that the steering angles cannot be changed while the crane 1 runs.

To this end, in the present invention, the steering

angle fixing section 80 is installed on any one of the front and rear separate bodies 30' and 30". The steering angle fixing section 80 is not specifically limited to a specific structure so long as it can securely maintain the front and rear separate bodies 30' and 30" at their predetermined steering angles, respectively. In this embodiment of the present invention, a rotating yoke 81 is mounted to any one (for example, the front separate body 30') of the front and rear separate bodies 30' and 30" to be integrally rotated therewith. The rotating yoke 81 is formed with several engaging grooves in a manner such that the engaging-grooves correspond to positions of the tires 40, which positions enable forward and backward movement, standing rotation and sideward migration of the transfer crane 1, respectively. The engaging grooves includes a first engaging groove 82 for forward and backward movement, a second engaging groove 83 for standing rotation, and a third engaging groove 84 for sideward migration. It is preferred to use the steering angle fixing section 80 which includes a fixing cylinder 85. The fixing cylinder 85 is installed on the support 21 of the underframe 20, adjoining the rotating yoke 81, and is actuated in a manner such that it selectively cooperates with one of the first through third engaging grooves 82, 83 and 84. An engaging pin 86 is reciprocatingly received at one end thereof in the fixing cylinder 85. The other end of the engaging pin

86 projects out of the fixing cylinder 85 toward the rotating yoke 81 so that it can be selectively engaged into one of the first through third grooves 82, 83 and 84 by the actuation of the fixing cylinder 85.

5 In this embodiment of the present invention shown in FIGs. 5 through 7, the first crank plate 62' to which the hydraulic cylinder 61 and the long connecting rod 71 are connected, also serves as the rotating yoke 81 of the steering angle fixing section 80, thereby to reduce the number of
10 components. In this respect, it is to be readily understood that separate members can be used to constitute the -first crank plate 62' and the rotating yoke 81, respectively.

 In the traveling device 10 according to the present invention, the tire rotating section 60 is precisely
15 controlled in a manner such that, when the forward and backward movement, standing rotation and sideward migration are effected, steering angles of the tires 40 are accurately set at 0°, standing rotation angles 21 and 22 inherently owned by the transfer crane 1, and 90°, respectively. At this time,
20 it is preferred that, in order to enable the steering angle fixing section 80 to fixedly maintain the tires 40 in their respective steered states at the time when the steering angles of the tires 40 are set as just described above, a plurality of limit switches 90 through 95 for controlling operations of
25 the steering angle fixing section 80 and the tire rotating

-24-

section 60 be installed adjacent to the steering angle fixing section 80 and the front and rear separate bodies 30' and 30'', as indicated by circles in FIG. 6.

For example, as illustrated in FIGs. 8 through 10, three
5 limit switches 90, 91 and 92 can be installed adjacent to the fixing cylinder 85 of the steering angle fixing section 80 in such a manner that they are spaced apart one from another to define a predetermined contour.

Also, as shown in FIG. 11, three further limit switches
10 93, 94 and 95 for the forward and backward movement, standing rotation and sideward migration, respectively, are securely installed on the support 21 of the underframe 20 adjacent to the rear separate body 30'' which is rotated around the supporting shaft 11'', in a manner such that they are arranged
15 in a vertical direction. In addition, three projections 93', 94' and 95' for the forward and backward movement, standing rotation and sideward migration, respectively, are formed on a circumferential outer surface of the rear separate body 30'' in a manner such that, as steering angles of the tires 40 are
20 changed, the three projections 93', 94' and 95' can be sequentially brought into contact with the three limit switches 93, 94 and 95, respectively. To this end, the projections 93', 94' and 95' are formed so that they are vertically and circumferentially spaced apart one from
25 another. A person skilled in the art will recognize that

-25-

distances between two of the projections 93', 94' and 95' must correspond to those between two of the limit switches 93, 94 and 95, respectively, to ensure reliable operations of the three limit switches 93, 94 and 95.

5 By the installation of the limit switches 90 through 95 in these ways, in a state as shown in FIG. 8 wherein the steering angle fixing section 80 is engaged into the first engaging groove 82 for forward and backward movement which engaging groove is defined in the rotating yoke 81 and thereby
10 the steering angles of the tires 40 are fixed as usual for the forward and backward movement of the transfer crane 1, that is, in a state wherein the limit switches 90, 91 and 92 are not brought into contact with the engaging pin 86 of the steering angle fixing section 80, if an operating lever is
15 manipulated for effecting the standing rotation of the transfer crane 1, the engaging pin 86 of the fixing cylinder 85 is disengaged from the first engaging groove 82 to be withdrawn. The withdrawal of the engaging pin 86 is stopped when the engaging pin 86 reaches a position where it can be
20 engaged into the second engaging groove 83 for standing rotation or a position where it is brought into contact with two limit switches 90 and 91 as shown in FIG. 9. Accordingly, the front separate body 30' is maintained in a state wherein it can be steered toward a position for enabling the standing
25 rotation of the crane 1.

-26-

If the withdrawal of the engaging pin 86 is stopped, after, for example, 1 or 2 seconds are lapsed, the hydraulic cylinder 61 of the tire rotating section 60 is actuated. Then, the rotation of the front separate body 30', the
5 actuation of the connecting section 70 and the rotation of the rear separate body 30" as aforementioned above with reference to FIGs. 5 through 7, are sequentially implemented. When the rear separate body 30" reaches the position which enables the standing rotation of the transfer crane 1, the limit switch 94
10 for standing rotation is brought into contact with the projection 94' for standing rotation as shown in FIG. 11, whereby the actuation of the hydraulic cylinder 61 is stopped and the steering operation for the standing rotation of the transfer crane is completed.

15 At this time, due to the fact that the rotation of the front separate body 30' is limited by the engaging pin 86 of the fixing cylinder 85 which is already moved to its position where it is engaged into the second engaging groove 83 for standing rotation, the traveling device 10 is fixedly
20 maintained at the steering angles enabling the standing rotation. By this, as described above, the steering operation by the traveling device 10 for enabling the standing rotation is completed. For reference, FIG. 10 illustrates a state wherein the fixing cylinder 85 is fully disengaged from the
25 first through third engaging grooves 82, 83 and 84 which are

-27-

formed in the rotating yoke 81 and the front separate body 30' can be freely rotated.

While it is described that the traveling device 10 is used for changing steering angles of the tires thereby to allow the transfer crane 1 to be moved from the forward and backward movement position to the standing rotation position, it is to be readily understood that other steering angle changing operations among the forward and backward movement, the standing rotation and the sideward migration can be conducted in a similar manner.

Furthermore, it will be readily understood that the locations and operations of the limit switches 90 through 95 as described above was given by way of example. As a consequence, in the case that the number, locations and operations of limit switches are otherwise modified, steering angles of the tires can be precisely changed to enable forward and backward movement, standing rotation or sideward migration, and the tire rotating section 60 and the steering angle fixing section 80 can be adequately controlled to properly fix changed steering angles.

The above stated components such as the travel driving section 50, the hydraulic cylinder 61 of the tire rotating section 60, the fixing cylinder 85 of the steering angle fixing section 80 and the like are constructed in a manner such that they can be controlled through a variety of

-28-

operating levers provided in a driver compartment, and detailed descriptions thereof will be omitted herein.

As a result, the traveling device of a transfer crane according to the present invention, constructed as mentioned above, provides advantages in that, per each underframe, by using one travel driving section, one tire rotating section, one connecting section and one steering angle fixing section, it is possible to reliably effect forward and backward movement, standing rotation and sideward migration of the transfer crane without experiencing inward or outward deviation of tires and fixedly maintain tires at respective steered angles for enabling the forward and backward movement, standing rotation and sideward migration of the transfer crane, respectively.

In the drawings and specification, there have been disclosed typical preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.

WHAT IS CLAIMED IS:

1. A traveling device of a transfer crane including a plurality of underframes each having front and rear separate
5 bodies to each of which at least one tire is mounted, the traveling device comprising:

a travel driving section mounted to at least one of the front and rear separate bodies of each underframe, for driving
tires;

10 a tire rotating section acting on one of the front and rear separate bodies of each underframe, for providing steering force to at least one tire mounted thereto;

a connecting section connected between the front and rear separate bodies in a manner such that a difference is
15 induced between steering angles of them, for transmitting the steering force which is provided to the one of them, also to the other of them; and

a steering angle fixing section for fixing steering angles of the front and rear separate bodies to desired ones.

20
2. The traveling device as claimed in claim 1, wherein the tire rotating section comprises a hydraulic cylinder.

25 3. The traveling device as claimed in claim 1,

-30-

wherein the travel driving section is installed on the rear separate body, and the tire rotating section and the steering angle fixing section are installed on the front separate body.

5 4. The traveling device as claimed in claim 1,
wherein the steering angle fixing section comprises a rotating
yoke which is mounted to one of the front and rear separate
bodies to be integrally rotated therewith and is formed with
engaging grooves in a manner such that the engaging grooves
10 correspond to steering angles of the tires which enable
forward and backward movement, standing rotation and sideward
migration of the transfer crane, respectively, and a fixing
cylinder having an engaging pin which is selectively engaged
into one of the engaging grooves to fixedly maintain a steered
15 state of one of the front and rear separate bodies.

 5. The traveling device as claimed in claim 4,
wherein a plurality of first limit switches are arranged
adjacent to the fixing cylinder, the first limit switches
20 functioning to stop the engaging pin at positions where it is
selectively engaged with the engaging grooves when one of the
front and rear separate bodies is steered to positions
enabling forward and backward movement, standing rotation and
sideward migration of the transfer crane, respectively.

-31-

6. The traveling device as claimed in claim 1, wherein a plurality of second limit switches are arranged adjacent to one of the front and rear separate bodies, the second limit switches functioning to stop an operation of the tire rotating section when one of the front and rear separate bodies is precisely steered to steering angles enabling forward and backward movement, standing rotation and sideward migration of the transfer crane, respectively.

7. The traveling device as claimed in any one of the claims 1 to 6, wherein the connecting section comprises a long connecting rod connected to one of the front and rear separate bodies, a short connecting rod connected to the other of the front and rear separate bodies, and a joint link having one end which is coupled to the underframe between the front and rear separate bodies and the other end to which the long connecting rod and the short connecting rod are connected.

8. The traveling device as claimed in claim 7, wherein the tire rotating section and the long connecting rod are connected at one ends thereof to a first crank plate which is installed in such a way as to be integrally rotated with one of the front and rear separate bodies, and the short connecting rod is connected at one end thereof to a second crank plate which is installed in such a way as to be

- 2 APR 2002

-32-

integrally rotated with the other of the front and rear
separate bodies.

5 9. The traveling device as claimed in claim 8,
wherein the rotating yoke and the first crank plate are made
of the same member.